GAC 863 REV. 2
8-74

GRUMMAN

MARINER
JUPITER ORBITER
PL-12-A
AUTOMATED PAYLOAD
(UPPER STAGE USED)
Volume V of VI

Prepared for

National Aeronautics and Space Administration
Marshall Space Flight Center
Huntsville, Alabama

by

Grumman Aerospace Corporation
Bethpage, New York 11714

Contract No. NAS 8-31102

OPERATIONS PLANNING SIMULATION

MODEL EXTENSION STUDY

FINAL REPORT

REPORT NO. SU OPS-RP-75-0001

PREPARED FOR
THE GEORGE C. MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA

CONTRACT NUMBER
NAS8-31102

PREPARED BY
GRUMMAN AEROSPACE CORPORATION
PRODUCT SUPPORT DEPARTMENT
BETHPAGE, NEW YORK

DATE: 1 February 1975

D. A. Marks, Study Manager
R. E. Gendiellee
T. M. Kelly
M. A. Giovannello

OPERATIONS PLANNING SIMULATION MODEL STUDY

(Contract NAS8-31102)

This is the final report of Contract NAS8-31102 and is submitted by the Grumman Aerospace Corporation, Bethpage, N. Y., in accordance with the terms and conditions of the contract.

The final report is packaged in six (6) volumes, entitled:

Volume I - Long Duration Exposure Facility (LDEF), Payload No. ST-01-A

Volume II - Life Sciences Shuttle Laboratory, Payload No. LS-09-S

Biomedical Experiments Scientific Satellite, Payload No. LS-02-A

Volume III - Dedicated Solar Sortie Mission (DSSM), Payload No. SO-01-S

Volume IV - Magnetic Spectrometer, Payload No. HE-15-S

Volume V - Mariner Jupiter Orbiter (MJO), Payload No. PL-12-A

Volume VI - Expanded Functional Flows and Descriptions

SUMMARY

I Study Objective

The objective of the Study was to evaluate the Launch Site Facility Requirements Data Sheets for selected Automated and Sortie Payloads.

The Study achieved the objective by:

- o Expanding the NASA launch site Level 0 functional flow activities to a depth required to identify payload launch site facility and support requirements (Volume VI contains the generic functional flow activities for Automated and Sortie payloads).
- o Conducting analyses of the payload definitions contained in the Level B Data issued by SSPD from the launch site ground processing viewpoint.
- o Processing the payloads through the expanded functional flow activities, and identifying the launch site facility and support requirements.
- o Comparing the generated requirements with those contained in the Launch Site Facility Requirements Data Sheets.

II Study Recommendations

Recommendations from the Study include:

- o Expansion and revision as appropriate of the Level B Data (SSPD) to define in detail the payload ground requirements, based upon the launch site functional flow activities, as well as performing Level II (not Level III) integration at the launch site.

Specific data sheets involved are:

- On-Orbit Checkout/Monitor/Control Equipment (Data Sheet No. A-9 and A-12)
- SKETCHES (Data Sheets No. A-10, S-5, and S-6), with emphasis on the configurations at launch site arrival and installed in Orbiter cargo bay.
- Interface Diagrams (Data Sheet No. S-7) showing the interfaces for monitoring and checkout during launch site ground processing.
- Data and Communications Checkout and Deployment Support/On-orbit Operations Support (Data Sheets No. A-14, A-15, S-19, and S-20).
- Launch/Landing Support Requirements (Data Sheets No. A-18 and S-22).
- Ground Facility Requirements (Data Sheets No. A-19 and S-23).
- Ground Environmental Limits (Data Sheets No. A-20 and S-24).

II Study Recommendations (Cont'd.)

- o Definition and descriptions to Level 4 or 5 of the launch site functional flow activities.
- o Investigation of payload ground requirements at the launch site which are identified as cost drivers for ground processing in this report.

III Future Investigative Areas

Cost effective processing of payloads at the launch site requires further studies and analyses. One area which would provide fruitful results is the generation of detail scenarios of representative payloads by disciplines for Payload Working Groups approval/modification. These detail scenarios would include the ground processing for:

- o Block 1.0 Activities - Payload Premission Processing
- o Block 2.0 Activities - Orbiter/Payload Integration and Checkout
- o Block 3.0 Activities - Prelaunch and Launch Operations
- o Block 4.0 Activities - Recovery Operations
- o Block 5.0 Activities - Post Mission Processing

Descriptions and required outline drawings would be provided to define in detail such ground functions and configurations as:

- o Payload and associated ground control and support equipment launch site arrival configurations, transportation and environmental modes, and arrival servicing and inspection/monitoring requirements.
- o Payload calibration
- o Monitoring
- o Checkout
- o Servicing
- o Intra-launch site transportation

The Grumman Aerospace Corporation would be pleased to assist the NASA/MSFC in performing additional studies and analyses to implement effective payload ground processing.

MARINER JUPITER ORBITER (MJO)

(PL-12-A)

AUTOMATED PAYLOAD (WITH IUS/OOS)

Functional Flow Descriptions and Payload Requirements for Ground and Launch Support Facilities

1.0 Introduction

Level B data (dated 7/24/74) for the Mariner Jupiter Orbiter (MJO) identifies the following:

- o A requirement of GN_2 purge, 1000 cleanliness class, for assembled spacecraft during ground operations (Data Sheet #A-20 - Ground Environmental Limits).
- o The use of RTG to supply MJO electrical power, and the RTG cooling requirement (amount TBD) which begins 23 hours prior to launch (Data Sheet #A-18).
- o The Cargo Bay air conditioning requirement which must provide the MJO Ground Environmental Limits contained in Data Sheet #A-20.
- o The use of MMH/N_2O_4 for propulsion fluids.
- o The use of hydrazine (N_2H_4) for Attitude Control System.
- o Assumes payload loading into Orbiter cargo bay at pad.
- o The use of a shroud over MJO.
- o The use of an Upper Stage (IUS/OOS/TUG) to inject MJO into heliocentric Earth-Jupiter transfer orbit.
- o Contains NO STERILIZATION requirements

The Study evaluated the above factors in defining a ground processing flow for the MJO, and concluded that the major problem in flow definition involves the MJO GN_2 purge while performing verification tests, mating with Upper Stage, and loading into Orbiter Cargo Bay. The requirement for GN_2 purge on previous planetary probes and the launch site support for this item are not known to Study personnel, however it is recommended that the MJO GN_2 purge requirement be investigated, since the Study feels that it is the driver in defining ground processing at the launch site.

Two approaches were considered for satisfying the GN_2 purge, and both involved the design of the shroud. Descriptions of the approaches follows:

- Shroud design permits maintaining a blanket GN_2 pressure on MJO which limits GN_2 resupply to only once per 24 hour period. With this shroud design, the Study recommends that the mated MJO and Upper Stage be horizontally loaded in the Orbiter Cargo Bay in the OPF.
- Shroud design requires constant supply of GN_2 purge. This design imposes

1.0 (Continued)

major problems on the ground process flow in supplying a continuous GN_2 purge. Difficulty areas involve movement of the MJO, and furnishing the GN_2 purge after MJO is installed in Orbiter Cargo Bay. To minimize these difficulty areas, the Study recommends that the mated MJO and Upper Stage be vertically loaded in the Orbiter Cargo Bay at the launch pad.

2.0 Recommended Functional Blow - Overview

The Study assumes that the shroud design requires the MJO to be supplied with a constant GN_2 purge which is the worst case condition from the ground processing viewpoint. An overview description of this flow is presented below. In addition, in paragraph 3.0 following, the ground and launch support facility requirements for processing the MJO and Upper Stage through the OPF are included.

Block 1.0 activities - Premission Payload Processing

Upon arrival at the launch site via C5A aircraft, the MJO is unloaded and transported to the IUS/TUG Processing Facility (KSC,Shuttle Project, Office, Schedule and Status Summary, Volume 2 - Payload Integration - dated 9/20/74 - identifies this facility also as SAEF-1 and PIB). The MJO remains in the IUS/TUG Processing Facility for post-transportation integrity tests, interface verification tests, and installation of its shroud.

After shroud installation, the MJO and IUS are mated in the IUS/TUG Processing Facility, and required interface verification tests are conducted. The integrated payload (mated MJO and IUS) then is loaded in a transporter and transferred to the launch pad for loading in Orbiter Cargo Bay.

Block 2.0 activities - Orbiter/Payload Integration and Checkout

The Study recommended flow does not process the MJO/IUS through the OPF, as loading is proposed to be accomplished at the launch pad. However, paragraph 3.2 following contains the facility requirements for Orbiter Cargo Bay loading in the OPF.

Block 3.0 activities - Prelaunch and Launch Operations

2.0 (Continued)

Block 3.0 (Cont'd.)

With the LMP at launch pad, payload Changeout bay extended, and Orbiter ready for loading, the MJO/IUS is hoisted from its transporter and inserted into the cargo bay, mated verified that latches are down.

The core materials of the RTGs are installed which assumes the design of RTG incorporates this feature, as well as shroud design permitting access to the RTG.

After installation in cargo bay, MJO monitoring will be initiated via Orbiter Ground Link. Payload/Orbiter interface verifications tests will be performed, followed by Launch Readiness Verification Checks.

The propellant loading of propulsion and Attitude Control Systems will be performed, after which the MJO will be secured for countdown and lift-off.

3.0 FUNCTIONAL FLOW DESCRIPTIONS AND PAYLOAD REQUIREMENTS FOR GROUND AND LAUNCH SUPPORT FACILITIES

Functional flow descriptions and launch site support requirements are contained in this paragraph. The flow is that recommended in paragraph 2.0 above. For information, paragraph 3.2 below describes the flow and contains the requirements if the MJO is processed through the OPF which the Study does not recommend since higher ground processing costs (quantity not determined) are involved in comparison to the suggested flow.

3.1 Block 1.0 Activities - Payload Premission Processing

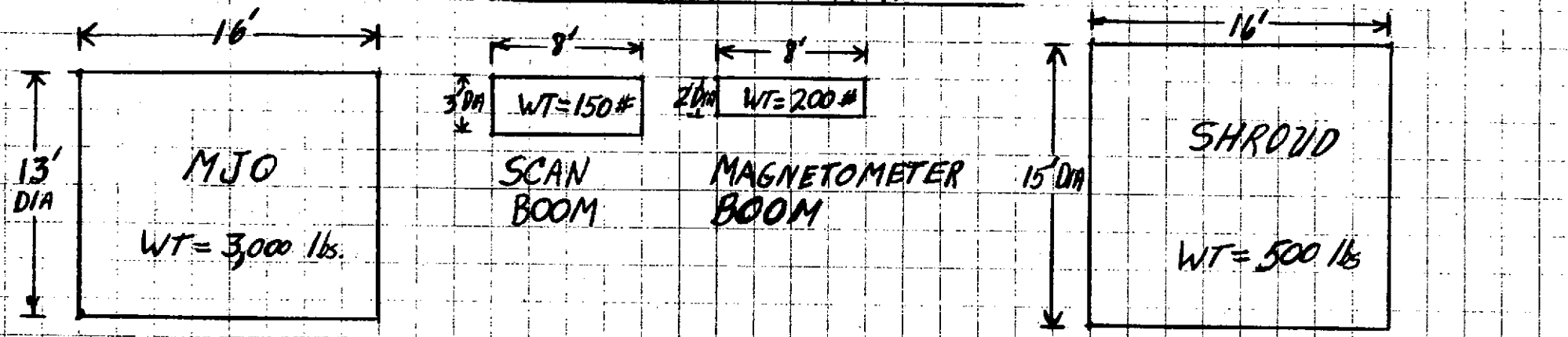
Level B data (July 1974) does not define the configuration of the MJO upon its arrival at the launch site. It is also noted that the Level B data defines typical science payload for study purposes and that specific experiments are currently TBD (Data Sheet #A-2). The Study uses the Configuration shown in Figure 3-1 for ground processing. Descriptions of the arrival configuration follow:

- o MJO - The MJO arrives via C5A aircraft, and is enclosed (less shroud, scan and magnetometer booms, and core of RTG) in an inner protective cover into which a constant GN_2 purge has been supplied during transit. The MJO outer shipping container contains displays for monitoring the GN_2 purge.

  Since Level B data does not contain detail definition of the shroud, scan and magnetometer booms, and RTG, the Study assumes that transportation and handling costs for the MJO program will be lowest in the recommended Configuration. In addition, the size of the MJO with installed shroud might be larger than the C5A aircraft can handle, noting that the MJO antenna has a 12 ft. diameter which the shroud encloses, and adding the dimensions for an outer shipping container, probably exceeds the 13.6 feet C5A loading dimension.

MARINER JUPITER ORBITER (MJO) CONFIGURATION

ARRIVAL AT LAUNCH SITE



CORE of RTG ARRIVES VIA AEC TRAILER

MJO GSE

FLUID

- PROPELLANT CONTROL ASS'Y (Two fuels, ONE OXIDIZER) (3'x5'x5' - WT-3,000 lbs)
- GN_2 REGULATOR PANEL (1'x1'x½' - WT-50 lbs)

ELECTRICAL

- COMMUNICATION TEST RACK (2'x3'x7' - WT-150 lbs)
- ELECTRICAL POWER REGULATION UNIT (2'x3'x7' - WT-175 lbs)

Figure 3-1

3.1 (Continued) Block 1.0 (Cont'd.)

- o SCAN and MAGNETOMETER BOOMS arrive via C5A aircraft in their respective shipping containers. Level B data does not contain special handling and transportation environmental requirements for these instruments.
- o SHROUD arrives via truck transportation. Level B data does not define the shroud, and the Study assumes it to be of rigid construction, suitable for the GN_2 purge. The design of the shroud includes access provisions for installing the core of the RTG, servicing including installation of pyrotechnics, and checkout interface connections.
- o CORE of RTG arrives via AEC trailer. The Study notes that the processing and handling of a RTG at the launch site may have been revised recently. The procedure described in the Study follows that of the Apollo program, where the core was inserted in the RTG during the final spacecraft close-out activities.
- o MJO GSE - The GN_2 Regulator Panel arrives with the MJO via C5A aircraft, and the remainder of the MJO GSE arrives via truck. All GSE is packaged in reusable shipping containers.

Block 1.1 Receive and Inspect Payload Elements

Block 1.1.1 - Payload elements arrive at launch site via C5A aircraft/truck, unloaded, and transported to the IUS/TUG Processing Facility/temporary storage

The MJO, Scan and Magnetometer booms, and GSE GN_2 Regulator Panel arrive by C5A aircraft. Using the Air Force 463L Material Handling System, these items are unloaded from the aircraft, and hoisted onto a flat bed trailer, and towed to the IUS/TUG Processing Facility. The MJO Shipping Container has an active GN_2 purging system which is functioning upon arrival. Its monitoring display is inspected during the unloading operation, and a contingency supply of GN_2

3.1 (Continued)

Block 1.1.1 (Cont'd.)

is listed as a launch site requirement for the unloading and transport to the IUS/TUG Processing Facility.

The core of the RTG arrives via AEC trailer which is parked in a remote area of the launch site. The core is handled and processed by AEC Technicians, and its launch site support and facility requirements are not considered further by the Study at this time.

The shroud arrives via truck, and is removed from the commercial carrier onto a flat bed truck, transported to temporary storage until required for MJO processing.

The MJO GSE arrives via truck, and is handled the same as the shroud.

Ground and Launch Support Facility Requirements

Facility Requirements

- o GN_2 (for contingency) at C5A unloading spot
- o Temporary Storage Area (hanger type satisfactory)
  - 54 ft. long, 30 ft. wide, and 20 ft. high for shroud and MJO GSE
- o IUS/TUG Processing Facility
  - 55 ft. long, 40 ft. wide, and 25 ft. high

Support Requirements

- o Air Force 463L Material Handling System
- o Flat bed trailer (10,000 lbs. capacity, 28 ft. long, 10 ft. wide)
- o Tow tractor
- o Mobil cranes (at Airfield and temporary storage area; 3,000 lbs. capacity)
- o Fork lift trucks (at Airfield and temporary storage area)
- o Hoisting slings for MJO, Shroud, and Propellant Control Assembly Shipping Containers
- o $2\frac{1}{2}$ ton, flat bed Truck

3.1 (Continued)

Block 1.1.1 (Continued)

- o Operators for above handling equipment
- o Riggers
- o Traffic Security Personnel
- o Procedures for monitoring GN_2 purge display on MJO Shipping Container

Block 1.1.2 Transport Shroud and MJO GSE from Temporary Storage Area to IUS/TUG Processing Facility

As required by the MJO processing schedule, the shroud and MJO GSE are transported from the temporary storage area to the IUS/TUG Processing Facility.

Ground and Launch Support Facility Requirements

Facility Requirements: None

Support Requirements:

- o Mobil crane (3,000 lbs. capacity)
- o Hoisting slings for Shroud and Propellant Control Assembly Shipping Containers
- o $2\frac{1}{2}$ ton flat bed truck
- o Fork lift truck
- o Operators for Crane and trucks

Block 1.1.3 - Unpack MJO elements, place in holding fixture, and perform post-transportation integrity inspection; move shipping containers to temporary storage.

The MJO, Scan and Magnetometer booms, and GSE GN_2 Regulation Panel are unloaded from the flat-bed trailer in the IUS/TUG Processing Facility and uncrated. To maintain cleanliness level in the IUS/TUG Processing Facility, the shipping containers and flat-bed trailer are cleaned prior to entry into the Facility. After uncrating, the MSO is placed on a movable holding fixture which is designed

3.1 (Continued)

Block 1.1.3 (Continued)

to also support the shroud, permit installation of the Scan and Magnetometer booms, and is compatible with the mating of the MJO and Upper Stage.

When removed from their shipping containers, the Scan and Magnetometer booms and the GN_2 Regulation Panel are placed on dollies.

The shroud and other MJO GSE items are unloaded from the truck, and uncrated. A cleaning activity is performed on the shipping containers prior entry into the IUS/TUG Processing Facility. All GSE is placed on dollies except the Propellant Control Assemblies which, due to their 3,000 lbs. weight, require special movable holding fixtures.

Once in its holding fixture/dolly, each MJO element is given a post-transportation inspection. Level B data does not contain specific definition to describe the inspection other than indicating the continuous GN_2 purge required by the assembled MJO.

The shipping containers are returned to temporary storage. The Study notes that there are scheduled two MJO launches, and assuming this to be the first, the shipping containers for flight hardware are returned for support of the second flight, and the non-flight hardware shipping containers are used to return the GSE hardware to the NASA Development Center.

Ground and Launch Support Facility Requirements

Facility Requirements

- o IUS/TUG Processing Facility
  - 30 ft. long, 30 ft. wide, and 20 ft. high which allows for MJO elements unpacking and installing in holding fixtures in series
- o GN_2 supply
- o Overhead crane in IUS/TUG Processing Facility (capacity 3,000 lbs.)

3.1 (Continued)

Block 1.1.3 (Cont'd.)

- o Temporary Storage Area

  -65 ft. long, 40 ft. wide, 20 ft. high for all MSO element shipping containers.

Support Requirements

- o Mobil crane in temporary storage area (capacity 1,000 lbs.)
- o Flat bed trailer and tow tractor
- o $2\frac{1}{2}$ ton, flat bed truck
- o Fork lift truck at IUS/TUG Processing Facility and temporary storage area.
- o Operators for above handling equipment
- o Hoisting slings for shipping containers
- o Riggers
- o Procedures, tools, and technicians for conducting the post-transportation integrity inspection
- o Movable holding fixtures for MJO, shroud, and Propellant Control Assembly.

Block 1.1.4 - Install Scan and Magnetometer Booms

From Level B data (Data Sheet #A-3), the Study assumes the Scan Boom weighs about 40 lbs.,and the Magnetometer Boom about 15 lbs., although it is again noted that the Level B data is defined as being typical for study purposes and that all instruments are currently (7/74) TBD. The assumed boom weights permit handling and installation by hand.

The requirement to continuously purge the MJO with GN_2 is satisfied by GN_2 bottles supplying the gas to the flexible liner which covers the MJO. The design of the liner permits boom installation without interrupting the purge.

Although not defined in Level B data, the Study assumes that mechanical and electrical connections are required for installation, and that no alignment/

3.1 (Continued)

Block 1.1.4 (Continued)

calibration is involved. It is also noted that NO interface checks are performed prior to the installation. The logic is that malfunctions which may have been caused in transportation will either have been detected during visual inspection or reveal themselves during the MJO functional check. It is also noted that the boom installation is a Level III type of integration, however it is felt that lower MJO program costs are realized by performing this installation at the launch site.

Ground and Launch Support Facility Requirements

Facility Requirements: None

Support Requirements

- o GN_2 bottle
- o Procedures, tools, and technicians for installation of booms.

Block 1.1.5 - Install Shroud and GN_2 Purge

The MJO inter liner is removed. The shroud is hoisted from its holding fixture and installed over the MJO. As mentioned previously, the design of shroud is compatible with the downstream MJO activities, and provides the MJO enclosure to satisfy the GN_2 purge requirement.

After the shroud is installed, the GSE GN_2 Regulator Panel and facility GN_2 supply (or GN_2 bottles) are connected, and furnish the purge throughout ground processing until the MJO is loaded in the Orbiter at the launch pad.

Ground and Launch Support Facility Requirements

Facility Requirements

- o GN_2 supply
- o Overhead crane (1,000 lbs. capacity)

3.1 (Continued)

Block 1.1.5 (Cont'd.)

Support Requirements

- o GN_2 Regulator Panel, and operating instructions
- o Procedures, tools, and technicians for removing MJO inter linen
- o Procedures, tools, and technicians for shroud installation
- o Procedures, tools, and technicians for connecting GN_2 Regulator Panel

Block 1.2 Verify Payload Elements

The Study defines the block as the interface verification activities required to satisfy the proper functional performance of the MJO at the launch site.

Based upon the Level B data, the following MJO interfaces are identified:

- MJO and Upper Stage: Data Sheet # A-14 indicates a data/communication interface, and there is a mechanical interface.
- MJO and Orbiter: Data Sheets #A-11, A-12, A-13, A-14, A-15, A-16, and A-18 indicate a data/communication interface, an electrical power interface, Air/GN_2 interface, servicing interface for fuels and oxidizer, TBD type of RTG cooling interface, and mechanical.
- MJO and Ground Control Net: Data Sheet #A-15 indicates communications and tracking (S/X bands) RF interface.

The following functional flow descriptions assume that the interface verification tests utilize the MJO Control Station in the AO Building, although it is recognized that detailed assignments of launch site functional responsibilities between the Launch Processing System (LPS) and the MJO Control Station have not been made. In this sense, the flows are considered preliminary and serve to identify the MJO ground and facility requirements.

Continuous GN_2 purge is supplied the MJO as described in Block 1.1.5.

3.1 (Continued)

Block 1.2.1 - Perform MJO - Upper Stage Interface Verification Tests

The MJO-Upper Stage interfaces are data/Communications (assumed umbilical connected) and mechanical. The MJO GSE is connected to the MJO, and supplies electrical power to the MJO for the interface verification tests. The MJO GSE provides the stimuli (duplicating the electrical performance of the Upper Stage) to the MJO, and receives and evaluates the MJO response. The Study anticipates that these tests require no new GSE, since the functions would have been performed previously at the NASA Development Center.

The mechanical interface between the MJO and Upper Stage need not be verified at the launch site in the opinion of the Study, provided the MJO has passed a fit test with an Upper Stage mechanical jig at the NASA Development Center and further provided that the MJO mechanical mating surfaces are capable of being visually inspected for damage during the post-transportation integrity inspection. If this be not the case, then the mechanical interface verification test is performed, using an Upper Stage mechanical jig.

Ground and Launch Support Facility Requirements

Facility Requirements

- o GN_2 supply
- o Electrical power - parameters are TBD
- o Overhead crane (1,000 lbs. capacity) - contingency for handling of Upper Stage mechanical jig.

Support Requirements

- o MJO GSE - for electrical power and simulate Upper Stage, receive/evaluate MJO response
- o Upper Stage mechanical jig - for contingency
- o Procedures, tasks and technicians for performing data/communications and and mechanical (contingency) interface verification tests

1 (Continued)

Block 1.2.2 Perform MJO - Orbiter Interface Verification Tests

The MJO-Orbiter interfaces are:

- o Data/communications
- o Electrical power
- o Air/GN_2
- o Servicing for fuels and oxidizer
- o TBD type of RTG cooling
- o Mechanical Support

The Study recommends performing interface verification tests only for data/communications and electrical power. The logic is that the fluid/mechanical interfaces have been tested previously at the NASA Development Center using some type of mechanical/fluid Orbiter simulation, and that these connections can be visually inspected at the launch site during the post-transportation integrity check, therefore a fluid/mechanical verification test is not required.

For data/communications and electrical power interface verification tests, MJO GSE is connected to the MJO to provide required MJO power. The Launch Processing System (LPS) is connected to the MJO, using appropriate Hardware Interface Modules (HIM), and the verification test is performed. It is noted that this procedure requires an LPS outlet in the IUS/TUG Processing Facility as well as an MJO HIM.

The logic for selecting the LPS for this verification test is that during Launch Readiness Verification and MJO monitoring activities during countdown at the pad, the LPS controls the ground operations, and the Study feels that employing the LPS during the interface tests satisfies compatibility requirements, as well as avoids duplication of ground test system.

3.1 (Continued)

Block 1.2.2 (Continued)

Ground and Launch Support Facility Requirements

Facility Requirements

- o LPS and MJO HIM in IUS/TUG Processing Facility
- o Electrical power - parameters are TBD

Support Requirements

- o MJO-GSE - for electrical power supply to MJO
- o Procedures, software, and operators for interface verification tests using LPS for control

Block 1.2.3 - Perform MJO - Ground Control Net Interface Verification Tests

The interface between the MJO and Ground Control Net is the communications and tracking (S/X bands) RF links. Although not defined in Level B data, the Study assumes that the MJO transmitters can be operated for these tests without the support of a GSE cooling supply. If this not be the case, the cooling requirements for transmitter operations should be defined. Also, the Study feels that it is not feasible for the antennas of the MJO to radiate, so the output of the transmitters is either fed through a coax to the AO Building, or fed to antennas mounted on the exterior of the IUS/TUG Processing Facility for RF transmission to the AO Building.

The MJO Control Station in the AO Building is selected for performing these interface verification tests. The logic is that the MJO Control Station duplicates the Ground Control Net for MJO operations after separation of MJO from Upper Stage, and its use for these interface verification tests avoids duplication of ground equipment. In addition, the Study assumes that the MJO Control Station equipment is available, since these test functions would have been performed previously at the NASA Development Center.

3.1 (Continued)

Block 1.2.3 (Cont'd.)

Ground and Launch Support Facility Requirements

Facility Requirements

- o MJO Control Station in AO Building
- o Coax or Antennas (S/X bands) between IUS/TUG Processing Facility and AO Building
- o Electrical power - in IUS/TUG Processing Facility and AO Building - parameters are TBD.

Support Requirements

- o MJO GSE for electrical power supply to MJO
- o Procedures, software, and operators in both AO Building and IUS/TUG Processing Facility for performing interface verification tests using MJO Control Station in AO Building

Block 1.3 - Prepare Payload Experiments for Integration

For the MJO, the preparation activities involve the removal of the protective covers over the mechanical and electrical mating interfaces with the Upper Stage.

Ground and Launch Support Facility Requirements

Facility Requirements: None

Support Requirements:

- o Procedures, tasks, and technicians for removing interface protective covers.

Block 1.4 - Verify Tug Carrier

(Verification of the Upper Stage is not applicable to the Study.)

Block 1.5 - Prepare Tug Carrier for Integration

(Preparation of Upper Stage is not applicable to the Study)

Block 1.6 - Mate Payload Elements

(The mating of the MJO and the Upper Stage is assumed by the Study to be performed by launch sitepersonnel, so no MJO ground requirements are listed for this activity.

3.1 (Continued)

Block 1.6 (Cont'd.)

If the decision is made to move the MJO to the Upper Stage for mating, the GSE GN_2 purge supply of the MJO must accompany the MJO. However, the transfer of the MJO to the Upper Stage may be less complicated than moving the Upper Stage to the MJO due to the size, holding fixture, and GSE of the Upper Stage. In any event, the transfer distance is small, as the Study assumes both units are in process in the IUS/TUG Processing Facility.)

Block 1.7 - Verify Integrated Payload

(The verification of the mated MJO-Upper Stage is assumed by the Study to be performed by launch site personnel, so no MJO ground requirements are listed for this activity. As noted in Block 1.2 above, all MJO interfaces have been verified. Assuming that all Upper Stage interfaces have been likewise verified, there is no hard requirement for verifying the integrated MJO-Upper Stage, since the only new equipment being exercised would be the umbilical connecting the MJO and the Upper Stage. The umbilical could have been verified by adding it to either the MJO or Upper Stage interface test, thus eliminating Block 1.7 activities.)

Block 1.8 - Perform Interface Check of Integrated Payload

(The interface check of the mated MJO-Upper Stage is assumed by the Study to be conducted by launch site personnel, so no MJO ground requirements are listed for the activity. As noted in Block 1.2 above, all MJO interfaces have been verified, and in so far as the interfaces between the MJO and Orbiter are concerned, there appears to be no hard requirement for performing verification tests through the interfaces as no non-exercised equipment appears to be involved, as discussed in Block 1.7 above.)

3.1 (Continued)

Block 1.9 - Move Integrated Payload to OPF (Orbiter Processing Facility)

(The Study recommendation is to load the mated MJO-Upper Stage in the Oribter Cargo Bay at the launch pad, and this block accomplishes the movement. Also, the move is performed by launch site personnel, and no MJO ground requirements are listed. It is noted that the MJO GSE GN_2 purge supply accompanies the movement of the mated MJO-Upper Stage from the IUS/TUG Processing Facility to the launch pad.

3.2 Block 2.0 Activities - Orbiter/Payload Integration and Checkout (PL-12-A)

The activities in this functional block begin with the arrival of the integrated payload elements at the mating area of the Orbiter Processing Facility and include all those efforts required to physically and functionally mate the payload to the Orbiter Payload Bay, and install any equipment required for the mission in the Payload Specialist Station. Figure 2.2-1 graphically depicts this flow.

The prerequisites of entering this block are as follows:

- o All elements requiring integration have been integrated.
- o Required GSE, STE, facility services and personnel are available.
- o Orbiter processing has progressed to the required point in its turnaround flow and is ready to accept the payload.

2.1 Install Mated Spacecraft and Upper Stage in Orbiter Payload Bay

Conditions: Spacecraft and upper stage are in position and access stands are in place.

2.1.1 Lock transporter in position and remove all transport covers.

2.1.2 Verify no transport damage has been incurred and payload and associated hardware is in a mate condition (visual inspection).

2.1.3 With the overhead crane in position, attach the auxiliary crane control to the hook and the hoisting GSE to the crane control. Raise the assembled functional set and attach to spacecraft/upper stage hoist points.

2.1.4 Using the auxiliary control, apply a load of TBD pounds as indicated on the dial face. Unlatch all transporter hold down points and raise payload clear of the transport unit.

2.1.5 Hoist and position in payload bay. Using the auxiliary control lower onto the orbiter support points.

2.1.6 Install all related mission equipment in the Payload Specialist Station.

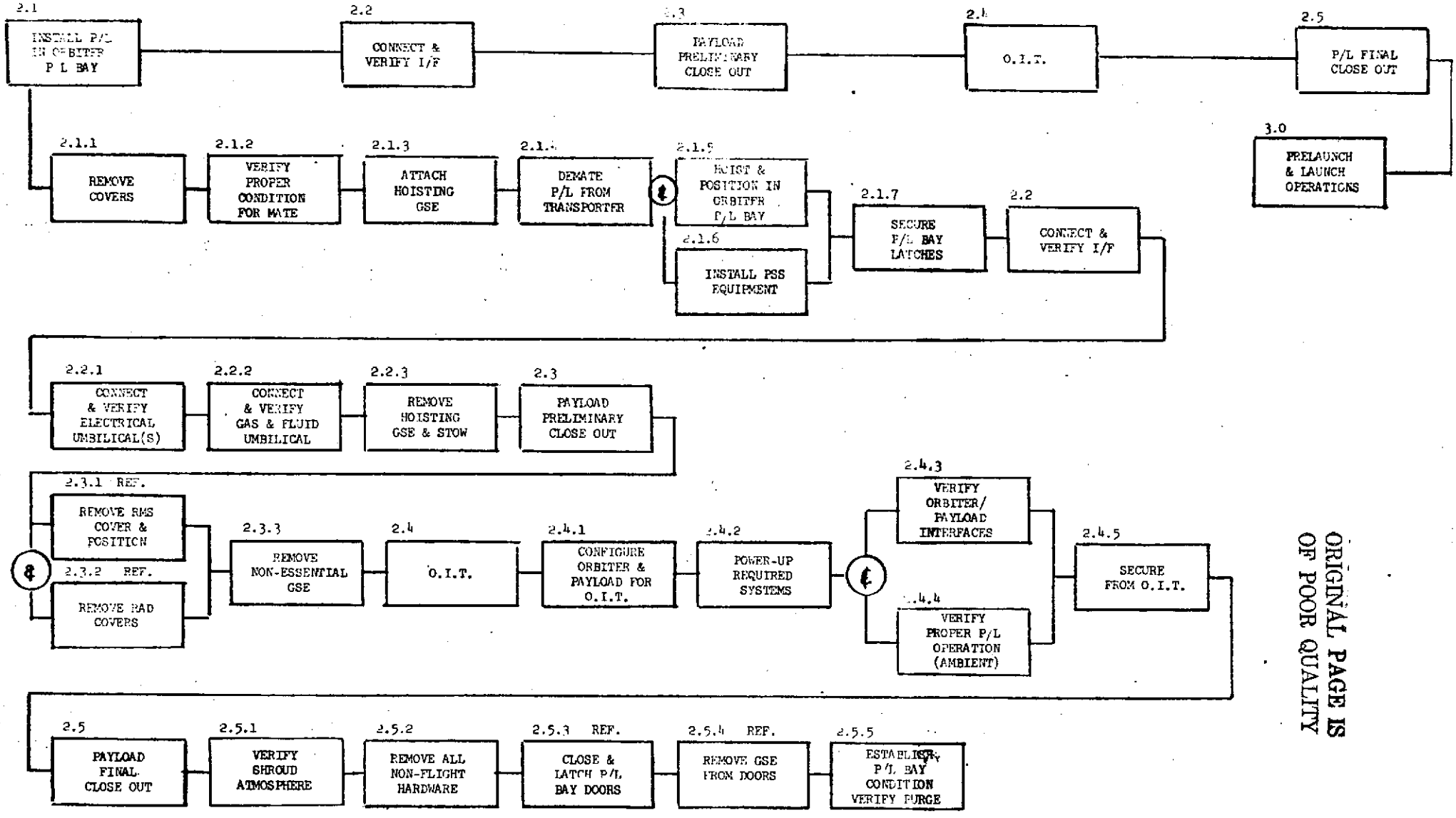


FIGURE 2.2-1 ORBITER/PAYLOAD INTEGRATION

2.1.7 Secure all payload bay latches and verify.

NOTE: Periodic check of the enshrouded spacecraft is required.

Reservice with certified GN_2 as needed.

Support Requirements Functional Block 2.1

Facilities

Floor space - 2686 sq. ft. (79' x 34')

Overhead crane - 10 ton capacity

115 VAC 1 ø 60 HZ (TBD KW)

28 VDC (TBD KW)

Ground Support Equipment

Hoist, Functional Set

Stands, Access

Auxiliary Crane Control

Regulating Unit GN_2

GN_2 Supply

Support

Crane Operator

Logistics

Procedures

2.2 Connect and Verify Orbiter/Payload Interfaces

Conditions: Payload is mechanically mated to the Orbiter and latch down has been verified.

2.2.1 Verify power off on both sides of the electrical interface. When verified, mate the Orbiter to Payload umbilical(s).

2.2.2 Verify no pressure or fluid present at either side of the fluid/gas interface, remove caps and mate fluid/gas umbilical.

2.2.3 Disconnect hoisting GSE and hoist clear of payload bay, retain in the area.

Support Requirements for Functional Block 2.2

Facilities

Same as 2.1.

Ground Support Equipment

Same as 2.1.

Support

Crane Operator

Logistics

Procedures

2.3 Payload Preliminary Closeout

Conditions: Spacecraft and upper stage have been physically and functionally mated to the Orbiter.

2.3.1 Remove protective covers from the Remote Manipulator System (RMS) arms. (Reference only not a payload function).

2.3.2 Remove protective covers from the payload bay door mounted radiators. (Reference only, not a payload function).

2.3.3 Remove all non-essential GSE and stow. Retain in area.

Support Requirements for Functional Block 2.3

Same as 2.1.

2.4 Perform Orbiter Integrate Test (OIT)

Conditions: Preliminary payload closeout has been completed. Orbiter support available and verified.

2.4.1 Configure orbiter, payload and associated GSE to support OIT position switches and circuit breakers per test procedures and verify.

2.4.2 Apply ground power to the required systems and verify proper level and distribution.

2.4.3 Verify functional path through Orbiter/Payload interface paths.

2.4.4 Verify proper signal format and level for all operating payload elements.

2.4.4.1 Figure 2.2-2 is a graphis representation of a typical anomaly loop and indicates various options in effecting corrective action. Once the anomaly has been isolated, the decision on which path to follow will be a "real time" decision hased on repair requirements and/or mission criticality. It is assumed that any anomaly associated with the Orbiter or the Institutional Ground Support Equipment will be the responsibility of KSC operational personnel, while anomalies within the payload elements or Peculiar Ground Support Equipment will be corrected by the payload operations personnel.

2.4.5 Upon final verifications of the correct readouts and functional interfaces, secure from O.I.T. power down active systems and position all switches and circuit breakers as called for in the O.I.T. procedures.

Support Requirements for Functional Block 2.4

Facilities

Same as 2.1.

Ground Support Equipment

Same as 2.1 plus

HIM's, LPS interface

Cable set, Checkout

Support

None.

Logistics

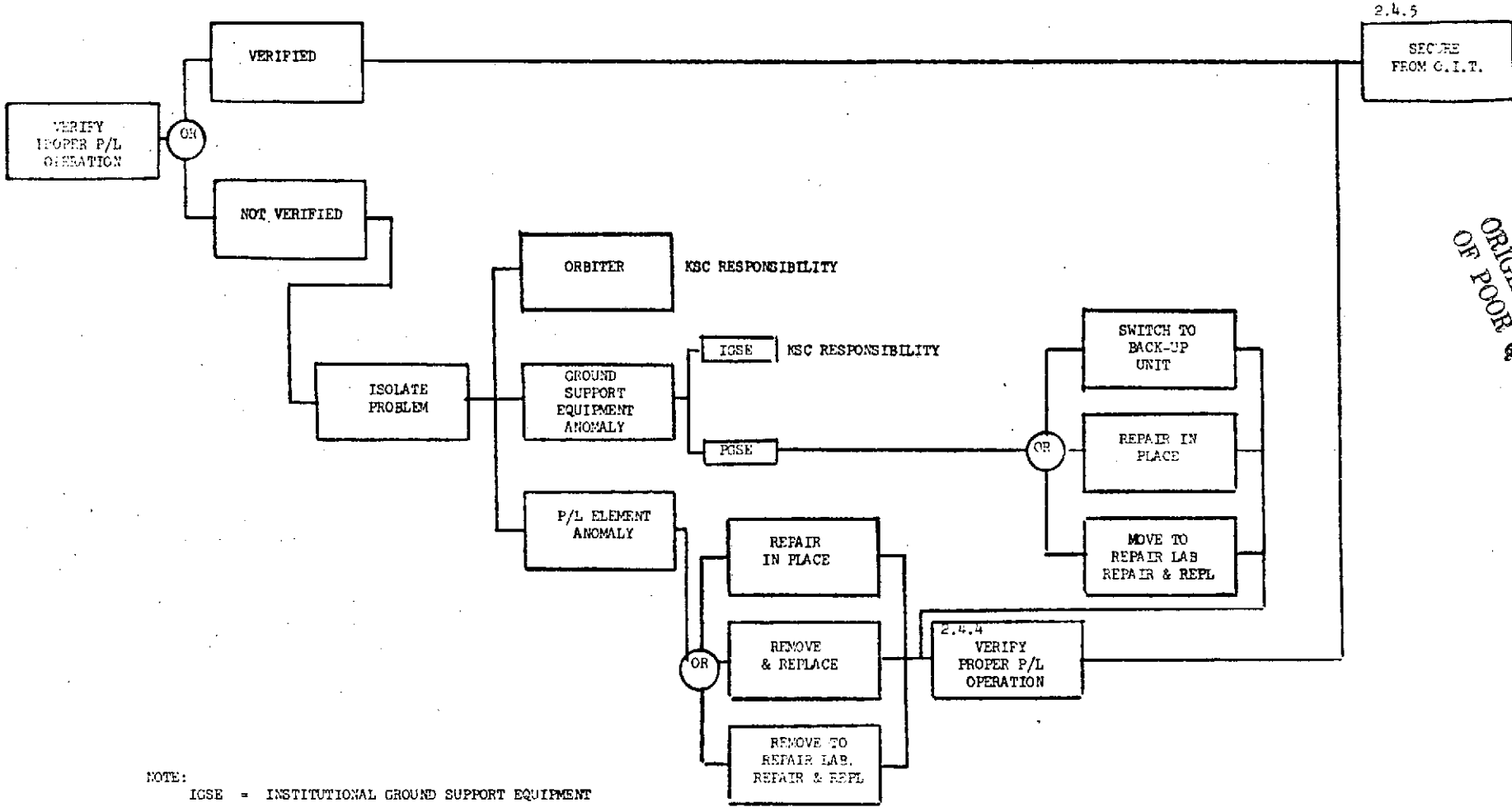
Procedures

2.5 Payload Final Close-out

Conditions: Orbiter Integrated Test has been completed. Orbiter and Payload have been secured.

2.5.1 Verify positive pressure within the shroud enclosure,; repressurize if required.

2.5.2 Remove all non-flight hardware from the payload bay and any non-flight equipment from the payload specialist station.



NOTE:
IGSE = INSTITUTIONAL GROUND SUPPORT EQUIPMENT
PGSE = PAYLOAD PECULIAR GROUND SUPPORT EQUIPMENT

FIGURE 2.2-2 TYPICAL ANOMALY FUNCTIONAL LOOP

2.5.2.1 Return all payload handling/checkout GSE to its proper position.

NOTE: This PGSE may be stored at the launch site or returned to the PI or CIS facility.

2.5.3 Close and latch payload bay doors, (Reference only, not a payload function).

2.5.4 Remove payload bay doors GSE and return to storage (Reference only, not a payload function).

2.5.5 Establish payload bay conditioning purge, verify payload bay conditioning within specification (Joint responsibility, Orbiter and Payload).

Support Requirements for Functional Block 2.5

Facilities

Same as 2.1

Ground Support Equipment

Regulating Unit GN_2

GN_2 Supply

Support

Crane Operator

Logistics

Procedures

Warehousing

This function ends with the Orbiter/Payload ready to prepare for transfer to the VAB.

3 Block 3.0 Activities - Prelaunch and Launch Operations

All payload operations covered in this Activity are mate Marine Jupiter Orbiter/IUS to Orbiter at the launch pad, launch readiness verification checks, and payload final servicing. The task and requirements for installation of the RTG's core are all described in this activity.

Block 3.1 Mate Payload with Orbiter

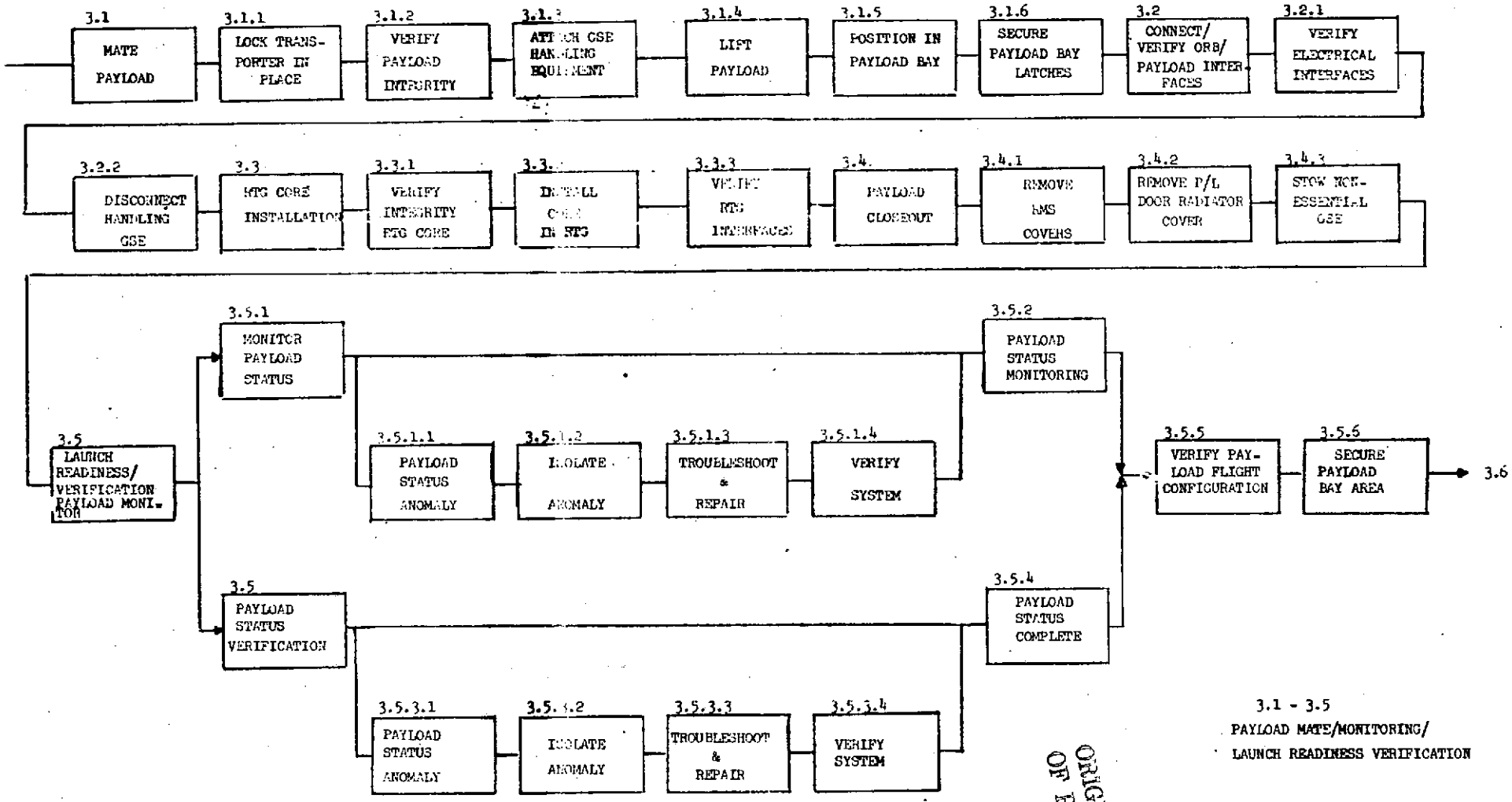
After MLP arrives at launch pad, and is hardmounted, begin preparations for installation/mating MJO/IUS. (Figure 3-1) The preparations include all those efforts required to physically and functionally mate the payload in the Orbiter Cargo Bay. After completion of payload mate, the RTG core installation requirements will be described as part of this functional activity. The prerequisites of entering this block are as follows:

- o All elements requiring integration have been integrated.
- o Required GSE, STE, facility services, and personnel are available.
- o Changeout payload bay is extended
- o Magnetic Jupiter Orbiter/Interim Upper Stage in position to off load from payload transporter.

Block 3.1.1 Lock transporter in position and remove all transport covers.

Block 3.1.2 Verify no transport damage has been incurred and payload and associated hardware is in a mate condition (visual inspection), and MJO blanket GN_2 purge is at the required TBD parameters.

Block 3.1.3 With the overhead crane in position, attach the auxiliary crane controls to the hook and the hoisting GSE to the crane control. Raise the assembled functional set and attach to MS pallet hoist points.



3.1 - 3.5
PAYLOAD MATE/MONITORING/
LAUNCH READINESS VERIFICATION

FIGURE 3.1 - 3.2

3.3 (Continued)

Block 3.1.4 Using the Auxiliary Control, apply a load of TBD pounds as indicated on the dial face. Unlatch all transporter hold down points and raise MS clear of the transport unit.

Block 3.1.5 Hoist, attach to payload bay rails, and position in bay.

Block 3.1.6 Secure all payload bay latches and verify.

Facility Requirements Functional Block 3.1

- o Transporter unload area - 30' x 30'
- o Overhead Crane - # TBD

Support Requirements Functional Block 3.1

- o Hoist, Functional Set
- o Auxiliary Crane Control

Block 3.2 Connect and Verify Orbiter/Payload Interfaces

The MS is mechanically mated to the Orbiter and latch down has been verified.

Block 3.2.1 Verify power off on both sides of the electrical interface. When verified, mate the Orbiter to Payload umbilical(s).

Block 3.2.2 Disconnect hoisting handling GSE and move clear of payload bay.

Facility Requirements Functional Block 3.2

- o Overhead crane - #TBD

Support Requirements Functional Block 3.2

- o None

Block 3.3 RTG Installation

With the installation of MJO in Orbiter Payload Cargo Bay, and Orbiter/Payload interfaces completed, the installation of the RTG's core can begin. The prerequisite of entering this block is that the RTG Handling Equipment and Support Cooling equipment are available and can support RTG installation.

3.3 (Continued)

Block 3.3.1 RTG Integrity Verification

After arrival from RTG storage area, verify integrity of RTG's core and prepare

Block 3.3.2 Install RTG's Core (3)

Connect up handing equipment, as required, to install RTG core to RTG. Position RTG's core in place and mechanically mate with RTG's.

Block 3.3.3 Verify RTG Core Interfaces and Connect Cooling

Verify RTG interfaces and RTG cooling parameters.

Facility Requirements Functional Block 3.3

- o None

Support Requirements Functional Block 3.3

- o None

Block 3.4 Payload Closeout

Payload and RTG's have been physically and functionally mated to the Orbiter.

Block 3.4.1 Remove protective covers from the Remote Manipulator System (RMS) arms.

Block 3.4.2 Remove protective covers from the payload bay door mounted radiators. (Reference Only - not a payload function)

Block 3.4.3 Remove all non-essential GSE and stow

Facility Requirements Functional Block 3.4

- o None

Support Requirements Functional Block 3.4

- o None

3.3 (Continued)

Block 3.5 Launch Readiness Verification/Payload Monitor

The MJO payload is mechanically mated to the Orbiter and latch down has been verified. The RTG's core installation is completed and RTG cooling is verified in spec. The payload ground support systems for continuous GN_2 purging is connected and verified operational. At this time, the monitoring of the MJO power-on system, caution and warning system, and environmental system will begin and continue through lift-off. In parallel, launch verification checks will be performed to verify the orbiter/payload interfaces, and the OBSS/PSS remote control systems to perform payload mission are operational.

Block 3.5.1 Monitor Payload Status

The GN_2 purge system is connected to payload for continuous purge through launch. The payload environmental control system, power system and caution and warning system is monitored remotely through Orbiter RF downlink to AO Hanger Facilities or LPS until liftoff.

Facility Requirements

- o Data Processing-via Orbiter Ground Link
- o Monitoring - AO Hanger, LPS
- o Fluids - GN_2, Water
- o Power - TBD

Support Requirements

- o None

Block 3.5.1.1 Payload Status Anomaly

During this activity, an anomaly could be loss of RTG power, which would result in loss of payload monitoring capabilities, or the loss of RTG cooling, ~~and~~ or environmental control, all of which would affect payload status and mission requirements.

3.3 (Continued)

Block 3.5.1.1 (Continued)

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Monitoring - via Orbiter Ground Link
- o LPS - CCMS
- o AO Hanger - Control Room
- o Power - TBD
- o Fluids - GN_2

Support Requirements

- o None

Block 3.5.1.2 Isolate Anomaly

The technician monitoring payload would have to observe conditions, and try to isolate problem to a particular system.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Monitoring - via Orbiter Ground Link
- o LPS - CCMS
- o AO Hanger - Control Room
- o Power - TBD
- o Fluids - GN_2

Support Requirements

- o None

Block 3.5.1.3 Troubleshoot and Repair

The technician/engineer will determine course of action to resolve anomaly and will proceed with troubleshoot and repair procedures.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Monitoring - Via Orbiter Ground Link
- o LPS - CCMS

3.3 (Continued)

Block 3.5.1.3 (Continued)

- o AO Hanger - Control Room
- o Power - TBD
- o Fluids - GN_2

Support Requirements

- o None

Block 3.5.1.4 Verify System

Upon completion of repair of system, a verification test would be performed to verify system functions as required to maintain integrity of payload.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Monitoring - via Orbiter Ground Link
- o LPS - CCMS
- o AO Hanger - Control Room
- o Power - TBD
- o Fluids - GN_2

Support Requirements

- o None

Block 3.5.2 Payload Status Monitoring

A continuous effort until liftoff to observe payload monitoring requirements function as required to maintain integrity of payload.

Facility Requirements

- o Power - TBD
- o Monitoring - via Orbiter Ground Link
- o Data Processing - via Orbiter Ground Link
- o AO Hanger - Control Room
- o LPS - CCMS
- o Fluids - GN_2, Conditioned Air

3.3 (Continued)

Block 3.5.2 (Cont'd.)

Support Requirements

o None

Block 3.5.3 Payload Status Verification

After installation of MJO, access to the PPS to perform an orbiter to payload interface verification. The verification would check the operational capabilities of the controls and switches required to deploy the payload on-orbit, and to verify caution and warning system is operational.

Facility Requirements

o Data Processing - via Orbiter Ground Link

o Power - TBD

o AO Hanger - Control Room

o Monitoring - via Orbiter Ground Link

o Data Processing - via Orbiter Ground Link

o Fluids - GN_2, Conditioned Air

Support Requirements

o None

Block 3.5.3.1 Payload Status Anomaly

During verification, an anomaly could appear which could jeopardize the mission. The anomaly could be lack of control or switches in PPS for operation of payload, or the data processing/recording system are inoperative due to interface problem or equipment failure, or loss of environmental monitor and control system. Whatever the anomaly, we would proceed to resolve anomaly prior to liftoff. (See Fig 3.2)

Facility Requirements

o Data Processing - via Orbiter Ground Link

o LPS - CCMS

o Power - TBD

3.3 (Continued)

Block 3.5.3.1 (Cont'd.)

- o Monitoring LPS
- o Fluids - GN_2, Conditioned Air, Water
- o AO Hanger - Control Room

Support Requirements

- o None

Block 3.5.3.2 Isolate Anomaly

The technicians/engineers performing the verification checks would isolate the anomaly to either Ground Support Equipment, Payload or Orbiter Systems. After the anomaly has been isolated, a typical approach to resolution of problem is shown on Figure 3.3. The GSE/Payload - Off-line maintenance would be performed by experimenter. Orbiter Systems maintenance resolution would be KSC responsibility.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o LPS
- o Power - TBD
- o Monitoring LPS/AO Hanger Control Room
- o Fluids - GN_2, Conditioned Air, Water

Support Requirements

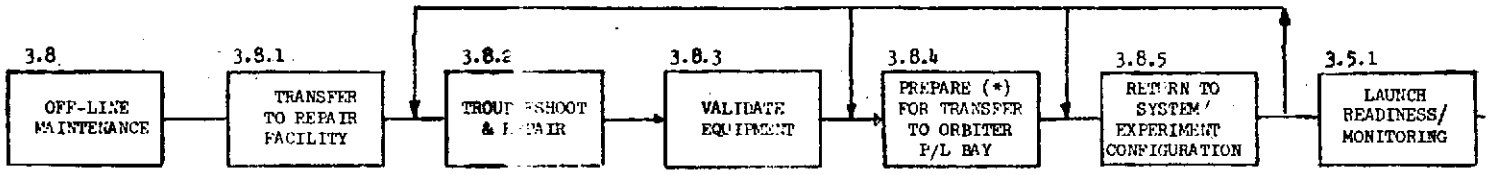
- o None

Block 3.5.3.3 Troubleshoot and Repair

A typical approach is shown on Figure

Facility Requirements

- o Radioactive Lab
- o Clean Lab



(*) TYPICAL EXPERIMENT/PAYLOAD/GSE - OFF-LINE MAINTENANCE FLOW

FIGURE 3.3

3.3 (Continued)

Block 3.5.3.3 (Cont'd.)

- o AO Hanger - Control Room
- o Film Lab
- o SAEF
- o Mech Lab
- o RTG Storage Area
- o Battery and Storage Lab
- o Hydrazine Load Area
- o Elect Lab
- o Ordnance Area

Support Requirements

- o Transportation
- o Handling Fixtures/Slings

Block 3.5.3.4 Verify Payload Status - Off-Line

After the resolution of the payload/GSE anomaly, a verification check would be made prior to installation in payload bay to show that it can now support the defined performance requirements of the mission.

Facility Requirements

- o Film Lab
- o Clean Lab
- o AO Hanger
- o SAEF
- o Elect Lab
- o Radioactive Lab
- o RTG Storage Area
- o Ordnance Area
- o Battery & Storage Lab
- o Mech Lab

3.3 (Continued)

Block 3.5.3.4 (Cont'd.)

Support Requirements

- o GSE -TBD
- o Special test equipment - TBD
- o Transportation
- o Handling Fixtures/Slings

Block 3.5.4 Payload Status Verification Complete

The verification check was performed with no problems, and if an anomaly did occur it has since been resolved and the payload is ready for flight.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o Power - TBD
- o LPS
- o Monitoring via Orbiter Ground Link
- o AO Hanger - Control Room
- o Fluids - GN_2 Conditioned Air, Water

Block 3.5.5 Verify Payload Flight Configuration

Prior to securing PPS and payload bay, a check is made to verify that all experiments, controls, switches, etc. are in flight readiness configuration.

Facility Requirements

- o Data Processing - via Orbiter Ground Link
- o AO Hanger - Control Room
- o Power - TBD
- o LPS
- o Monitoring - via Orbiter Ground Link
- o Fluids - GN_2 Conditioned Air, Water

SUMMARY

I Study Objective

The objective of the Study was to evaluate the Launch Site Facility Requirements Data Sheets for selected Automated and Sortie Payloads.

The Study achieved the objective by:

- o Expanding the NASA launch site Level 0 functional flow activities to a depth required to identify payload launch site facility and support requirements (Volume VI contains the generic functional flow activities for Automated and Sortie payloads).
- o Conducting analyses of the payload definitions contained in the Level B Data issued by SSPD from the launch site ground processing viewpoint.
- o Processing the payloads through the expanded functional flow activities, and identifying the launch site facility and support requirements.
- o Comparing the generated requirements with those contained in the Launch Site Facility Requirements Data Sheets.

II Study Recommendations

Recommendations from the Study include:

- o Expansion and revision as appropriate of the Level B Data (SSPD) to define in detail the payload ground requirements, based upon the launch site functional flow activities, as well as performing Level II (not Level III) integration at the launch site.

Specific data sheets involved are:

- On-Orbit Checkout/Monitor/Control Equipment (Data Sheet No. A-9 and A-12)
- SKETCHES (Data Sheets No. A-10, S-5, and S-6), with emphasis on the configurations at launch site arrival and installed in Orbiter cargo bay.
- Interface Diagrams (Data Sheet No. S-7) showing the interfaces for monitoring and checkout during launch site ground processing.
- Data and Communications Checkout and Deployment Support/On-orbit Operations Support (Data Sheets No. A-14, A-15, S-19, and S-20).
- Launch/Landing Support Requirements (Data Sheets No. A-18 and S-22).
- Ground Facility Requirements (Data Sheets No. A-19 and S-23).
- Ground Environmental Limits (Data Sheets No. A-20 and S-24).

II Study Recommendations (Cont'd.)

- o Definition and descriptions to Level 4 or 5 of the launch site functional flow activities.
- o Investigation of payload ground requirements at the launch site which are identified as cost drivers for ground processing in this report.

III Future Investigative Areas

Cost effective processing of payloads at the launch site requires further studies and analyses. One area which would provide fruitful results is the generation of detail scenarios of representative payloads by disciplines for Payload Working Groups approval/modification. These detail scenarios would include the ground processing for:

- o Block 1.0 Activities - Payload Premission Processing
- o Block 2.0 Activities - Orbiter/Payload Integration and Checkout
- o Block 3.0 Activities - Prelaunch and Launch Operations
- o Block 4.0 Activities - Recovery Operations
- o Block 5.0 Activities - Post Mission Processing

Descriptions and required outline drawings would be provided to define in detail such ground functions and configurations as:

- o Payload and associated ground control and support equipment launch site arrival configurations, transportation and environmental modes, and arrival servicing and inspection/monitoring requirements.
- o Payload calibration
- o Monitoring
- o Checkout
- o Servicing
- o Intra-launch site transportation

The Grumman Aerospace Corporation would be pleased to assist the NASA/MSFC in performing additional studies and analyses to implement effective payload ground processing.

3.3 (Continued)

Block 3.5.5 (Cont'd.)

Support Requirements

o None

Block 3.5.6 Secure Payload Bay Area

Secure all PPE used in verification checks between PPS and payload.

Facility Requirements

o None

Support Requirements

o None

Block 3.6 Payload Final Servicing

During this period, the payload will be monitored, as in Activity 3.5.1 through liftoff. The payload final servicing will be loading of payload Propulsion System and the Attitude Control System. Access is required to payload bay area for final servicing and verification. After servicing the payload/orbiter will be secured and the Orbiter Shuttle will proceed with countdown and liftoff.

Block 3.6.1 Access for Final Servicing

Access is required through payload changeout room to payload bay to prep. for propellant loading.

Facility Requirements

o Payload Changeout Room

Support Requirements

o None

Block 3.6.2 Propellant Loading Preparations

Install/connect GSE servicing equipment to payload in preparation for loading the Propulsion Stage (MMH/N2O4) and the Attitude Control System (N_2H_4)

3.3 (Continued)

Block 3.6.2 (cont'd.)

Facility Requirements

- o Payload Changeout Room
- o Fluids - MMH/N2O4, N_2H_4, GN_2
- o Power - TBD
- o Monitoring - LPS

Support Requirements

- o GSE - TBD

Block 3.6.3 Load Fluids

Preparations completed, load propellant system and Attitude Control System.

Facility Requirements

- o Payload Changeout Room
- o Fluids - MMH/N2O4, N_2H_4, GN_2
- o Power - TBD
- o Data Processing - via Orbiter Ground Link
- o Monitoring - LPS

Support Requirements

- o GSE - TBD
- o Safety

Block 3.6.4 Final Servicing Complete

Propellants are loaded, and payload is now ready to support its mission in orbit.

Facility Requirements

- o Monitoring - LPS
- o Data Processing - via Orbiter Ground Link
- o Power - TBD

Support Requirements

- o None

3.3 (Continued)

Block 3.6.4.1 Secure Facilities

Secure all facilities on MLP and Payload Changeout Room in support of payload verification checks and servicing.

Facility Requirements

- o None

Block 3.6.4.2 Secure/Disconnect GSE

Secure/disconnect all GSE on MLP, Payload Changeout Room, used in support of payload, verification checks and servicing.

Facility Requirements

- o None

Support Requirements

- o Transportation - TBD
- o Safety

Block 3.6.5 Secure Orbiter

Payload bay, payload/experiments are now completely secured and launch operations can proceed toward countdown and liftoff.

Facility Requirements

- o None

Support Requirements

- o None

Block 3.7 Off-Line Support

Off-line support is any activity required for support of verification, servicing, monitoring, etc. that will be used to support the processing of the payload through Launch Operations.

3.3 (Continued)

Block 3.7.1 Prepare GSE*Propellant Servicing Equip

The preparations are an off-line activity for loading propellants on payload during final servicing. Includes disassembly/assembly of GSE for cleaning, calibration and proofing of hoses.

Facility Requirements

- o Mech Lab with laminar flow bench
- o Clean Lab
- o Calibration Lab

Support Requirements

- o Transportation - TBD
- o GSE - TBD

Block 3.7.2 Validation of GSE*

Functional test of GSE* prior to servicing.

Facility Requirements

- o Mech Lab
- o Power - TBD
- o Fluids - GN_2

Support Requirements

- o GSE - TBD

Block 3.7.3 Transferring GSE* to Area for Hydrazine Loading Area

Facility Requirements

- o None

Support Requirements

- o Transportation - TBD

Block 3.7.4 Service GSE*

Configure GSE*, load, and verify GSE are ready to support top-off of payload experiment.

3.3 (Continued)

Block 3.7.4 (Cont'd.)

Facility Requirements

o Fluids - GN_2, MMH/N_2O_4, N_2H_4, water

o Power - TBD

Support Requirements

o GSE - TBD

Block 3.7.5 Transfer GSE* to MLP

Upon completion of servicing transfer GSE* to MLP to support top-off of payload.

Facility Requirements

o None

Support Requirements

o Transportation - TBD

Block 3.8 Typical Off-line Maintenance - Payload/GSE

The off-line maintenance for payload, subassemblies, and GSE in direct support of the payload, and GSE in direct support of the experiment is the responsibility of the experimenters. The maintenance is performed in the support facilities, required for trouble-shooting, repair, and verification, as defined in Facilities Requirements for their particular payload/GSE. A typical off-line maintenance flow is shown in Figure 3.3.

Block 3.8.1 Transfer to Repair Facility

Initial step in off-line maintenance is to transfer payload/GSE to specific facility required to support maintenance of anomaly.

3.3 (Continued)

Block 3.8.1 (Cont'd.)

Facility Requirements

- o Film Lab
- o Clean Lab
- o Radioactive Lab
- o Calibration Lab
- o SAEF
- o Battery and Storage Lab
- o Hydrazine Load Area
- o Elect Lab
- o AO Hanger
- o Mech Lab
- o Ordnance Area
- o RTG Storage Area

Support Requirements

Block 3.8.2 Troubleshoot and Repair

Perform all steps necessary for trouble-shooting and repair of experiment/payload/GSE anomaly.

Facility Requirements

- o Cleaning Lab
- o Radioactive Lab
- o Calibration Lab
- o Hydrazine Load Area
- o Battery and Storage Lab
- o SAEF
- o Elect Lab
- o AO Hanger

3.3 (Continued)

Block 3.8.2 (cont'd.)

- o Film Lab
- o RTG Storage Area
- o Ordnance Area

Support Requirements

- o Logistics Spares

Block 3.8.3 Validate Equipment

Performance of test to verify anomaly has been repaired and payload subassemblies/GSE is ready to support mission.

Facility Requirements

- o Power - TBD
- o Fluids - TBD
- o Gases - TBD

Support Requirements

- o Test Equipment - TBD
- o Support GSE - TBD

Block 3.8.4 Prepare (*GSE) for Transfer to Orbiter Payload Bay

Perform all steps necessary to prepare *, (payload subassemblies/GSE) for transfer back to Orbiter Payload Bay, while still maintaining integrity of experiment.

Facility Requirements

- o Power - TBD
- o Fluids - TBD
- o Gas - TBD

Support Requirements

- o Transportation
- o Handling Fixtures

3.3 (Continued)

Block 3.8.5 Return to System/Experiment Verification

Reinstall payload assemblies, GSE back to configuration to support mission. Verify electrical/mechanical interfaces as required, and verify mission support capabilities of system.

Facility Requirements

- o Power - TBD
- oo Fluids - GN_2, Water
- o Gas - TBD
- o Data Processing - via Orbiter Ground Link
- o Monitoring LPS
- o AO Hanger - Control Room

Support Requirements

- o TBD

Block 3.9 Typical - Payload/Orbiter - Maintenance Flow

The Orbiter Support System for Payloads are Orbiter (KSC) responsibility. If an anomaly occurs between the interfaces, such as in the Data Processing System or Environmental System, the appropriate Orbiter (KSC) representative would be notified and KSC would proceed with resolving anomaly. After resolution, interfaces would be verified to determine if now payload is ready to support its mission in orbit.

Facility Requirements

- o KSC Responsibility

Support Requirements

- o KSC Responsibility

4.0 Evaluation of Information on Data Sheet (Functional)

The launch site processing upon which the requirements are listed in the Data Sheet (Functional) appears to follow the automated baseline flow for the launch site. The Data Sheet for Activity 1.0 - Payload Premission Activity - includes a note that this activity could require two different facilities, and includes an ESF (Explosive Safe Facility) reference in Block 1.6 - Mate Payload Elements. Since the Study-generated requirements are based upon a revised flow, a comparison of the Study requirements and Data Sheet (Functional) information would not be meaningful.

The evaluation contained in the following paragraphs discuss Data Sheet (Functional) information which appear inconsistent with the automated flow baseline and MJO Level B data definition.

4.1 Activity 1.0 - Payload Premission Processing

Block 1.1 - Receive and Inspect Payload Elements

A. Experiment/Payload Area Requirements Lenth (FT) = 19; Width (FT) = 12; Min. Height (FT) = 20 Comment: The Cargo bay configuration of the MJO is 19 ft. long and 12 ft. in diameter. Making allowance for holding fixture, work stands, and clearance area, it seems that an area of 55 ft. long, 40 ft. wide, and 25 ft. high would be more suitable.

B. Fluids

Data Sheet includes requirements and lists parameters for Air and GN_2.

Comment: The requirements for Air and GN_2 are included in Data Sheet #A-19 - Ground Facility Requirements - Level B data. Also, Data Sheet #A-20 - Ground Environmental Limits - indicates that GN_2 purge is required for ground operations with assembled spacecraft. Assuming that Level III integration at the launch site will be limited to the installation of booms, shroud, and core of RTG, there appears to be no requirement for Air.

4.1 (Continued)

Block 1.1 (Cont'd.)

C. AC Power

Data Sheet includes a requirement for 60 KW of 120/208 VAC, 60 cycle, single phase power. Comment: The Study recommends the power requirements as TBD at this time, due to lack of detail definition in Level B data.

Block 1.2 - Verify Payload Experiments

The requirements contained in the Data Sheet (Functional) are same as for Block 1.1 above, and will not be duplicated here.

This block has a note which states that the spacecraft will be encapsulated for cleanliness. Comment: Study is unable to locate the encapsulation item in Level B data. Data Sheet #A-8, block 17, includes a suggestion that contamination protective cover be standard for all JPL S/C flown on Shuttle, but this note is not interpreted to indicate an encapsulation function.

Block 1.3 - Prepare Payload for Integration

Same requirements and comments as Block 1.1 above.

Block 1.6 - Mate Payload Elements (ESF)

Data Sheet (Functional) includes a requirement for hydrazine, air, and helium. Comment: Study assumes that hydrazine will be loaded at the launch pad, and not during Block 1.6 activities. The requirement for air and helium could not be identified in the Level B data.

Block 1.7 - Verify Integrated Payload

Block 1.8 - Interface Check

Block 1.9 - Move Payload to OPF

Data Sheet (Functional) lists requirements for these three blocks similar to Block 1.1 above, and the same comments apply.

LAUNCH SITE SUPPORT REQUIREMENTS (FUNCTIONAL)

MARINER JUPITER ORBITER

4.2 Block 2.0 Activities - Orbiter/Payload Integration and Checkout

Block 2.1 Install Payload in Orbiter Bay Area Requirements (28'L x 12'W x 60'h)

The KSC Shuttle System Ground Operations Plan, K-SM-09 states that payload requiring a tug (upper stage) will be mated to the upper stage prior to mating the orbiter, therefore the space required in the mating area must include accommodations for the payload plus the upper stage as well as work stands and access aisles. Assuming an upper stage length of 30'L x 14'D and allowing 4' stands, 6' for access aisles, plus a 10' wide area aft of the payload for benches, roll arounds etc. The recommended area would be 79'L x 34' wide. Hook height of 60' is adequate.

Temperature Requirements, Function 2.1-2.5 (278/306°K)

This temperature range, equivalent to 41/91°F produces an environment not conducive to efficient working conditions, the recommended range is 295±1°K.

Relative Humidity Function 2.1 - 2.5 (60%)

It is recommended that the relative humidity be established at 50 ± 10% to allow for variations in weather conditions.

Cleanliness Class Function 2.1 (100,000)

No change

Cleanliness Class Function 2.2-2.5 (Note 1 1000)

Note 1 references a payload bay requirement; JSC document JSC 07700 volume XIV defines the payload bay environment as 100,000 class. The class 1000 in the Data Sheet is a product cleanliness class not an area specification.

Fluid Requirements Function 2.1-2.5

No change.

4.3 Block 3.0 Prelaunch and Launch Operations

This activity is being reviewed and analyzed as if MJO is processed through OPF, even though GAC recommended and described mating of payload and pad. (Ref. 3.0 Activity 3.0).

Block 3.1 Move Shuttle to Pad

A. Payload Processing Area

(Temp - 278 - 308°K)

(Rel. Humid - 60%)

(Cleanliness Class - 1000)

(⚠1 Payload Bay environment)

The above requirements are not facility requirements, they are requirements that are to be maintained while the MJO is encapsulated in a GN_2 pressurized shroud. The payload cargo bay will be environmental controlled to the following parameters: Temp - 282-320°K, Cleanliness Class 100-000, Rel. Humidity - Air 0 -90%, GN_2 0 - 10% Flow Rate - 0-200 lbs/min.

B. D. C. Power

(28 VDC, 1.0 KW)

Per the level "B" data sheets, Payload Electrical Power Requirements Sheet A-13, states'MJO will be powered by 3MHW RTG - Requiring no power from the shuttle. The level "B" data sheet Ground Facility Requirements, sheet A-19 doesn't show a 28 VDC requirement at the launch site. Since all monitoring is per RF downlink via orbiter to AO Hanger or LPS, the only power requirement should be a power requirement for the Control/Monitoring Equipment in AO Hanger of the LPS Console.

C. AC Power

(120/208 VAC, 60 HZ, 1 PH, 2 KW)

4.3 (Continued)

Block 3.1, C. (Cont'd.)

No facility AC Power requirement can be defined at this time, since the level "B" data sheet Payload Electrical Power Requirements states" MJO will be powered by 3 MHW RTG - requiring no power from the shuttle. And as stated in paragraph "B" above, no local monitoring is required, all monitoring is via RF to AO Hanger or to LPS.

D. Payload Peculiar Equipment

(40 sq. ft.)

At this time, a requirement of 40 sq. ft. is questionable, since all monitoring activities are via RF open loop to AO Hanger or LPS.

Block 3.2 Launch Readiness/Orbiter Cabin Closeout

A. Payload Processing Area

(Temp - 278-308°K)

(Ref. Humid - 60%)

(Clean. Class - 100,000)

(⚠ Payload Bay Environment)

Refer to 3.1 paragraph A for comments

B. DC Power

(28 VDC, 2 KW)

Refer to 3.1 paragraph B for comments

C. AC Power

(120/208 VAC, 60 HZ, 1 PH, 5 KW)

Refer to 3.1 paragraph C for comments

Block 3.3 Payload Final Servicing

A. Payload Processing Area

(Temp - 278-308°K)

(Rel. Humid - 60%)

(Clean Class - 100,000)

4.3 (Continued)

Block 3.3 A. (Cont'd.)

(⚠ Payload Bay Environment)

Refer to 3.1 paragraph A for comments.

B. DC Power

(28 VDC, 1.0 KW)

Refer to 3.1 paragraph B for comments. However power is required for GSE servicing equipment - Power (TBD)

C. AC Power

(120/208 VAC, 60 HZ, 1 PH, 5 KW)

Refer to 3.1 paragraph C for comments. However power is required for GSE servicing equipment - Power (TBD).

5.0 Evaluation of Information on Data Sheet (Physical)

The launch site processing upon which the requirements are listed in the Data Sheet (Physical) appears to follow the automated baseline flow. Since the Study-generated requirements are based upon a revised flow, a comparison of the Study requirements and Data Sheet (Physical) information would not be meaningful.

The evaluation contained in the following paragraphs discuss Data Sheet (Physical) information which appear inconsistent with the automated flow baseline and MJO Level B data definition.

5.1 Activity 1.0 - Payload Premission Processing

A. Storage Area

Data Sheet (Physical) lists storage area requirements for RTG, solid motor, and spacecraft. Comment: The Study processes the core of RTG in a manner similar to the Apollo program, although noting that launch site handling of RTG may have been revised recently. The Study assumes the solid motor (kick motor, subsystem 005) is installed in the MJO prior arrival at the launch site and remains installed throughout launch site processing (which the Study understands is the current method of launch site processing of the Viking Program). Finally, the Study transports the spacecraft directly to the IUS/TUG Processing Facility upon launch site arrival, and therefore identifies no storage requirement for the spacecraft.

B. Maintenance and Repair

Data Sheet (Physical) indicates usage of various Shops and laboratories.

Comment: Study recommends adding a note for use in contingencies, as no shop/laboratory use is planned/scheduled.

C. Special Area Requirements

Same remarks as paragraph B above.

5.2 Block 2.0 Activities - Oribter/Payload Integration and Checkout (Storage Area 500 ft^2)

There is no specific storage task in this functional block. The RTG fuel capsule has been stored in Functional block 1.0 and will not be moved until it is loaded prior to flight. Storage in the immediate mate area for tools etc. has been shown as part of the Functional Requirements.

There are no other recommended changes.

5.2 (Continued)

Block 2.1 (Cont'd.)

DC and AC Power Requirements

There is insufficient data in the Level 'B' description to warrant a change recommendation.

Special Handling (3000# OH crane)

Assuming the weights tabulated on Data Sheet, A-9 are additive to the equipment weight (dry) on sheet A-5, a combined weight for the Mariner Jupiter Orbiter becomes 3822 kg adding the upper stage dry weight of 2721 kg, the weight to be lifted is 6543 kg or 14,427 pounds.

Recommended a crane of 8 ton capacity.

No other recommended changes.

5.3 Block 3.0 Prelaunch and Launch Operations

A. Storage Area

(Area - 200 sq. ft. - GDC Est.)

(Temp - 278 to 306°K)

(Rel Humid - 60%)

(Clean Class - 100,000)

Storage area facilities are not required in support of this activity. Storage requirements are stated in Activity 1.0.

3.7 and 3.8 Off-line Support

On a contingency basis, the Mariner Jupiter Orbiter should have the capabilities to perform any maintenance, repair, servicing, and checkout to support the launch mission. Although the requirement is on a contingency basis, the following requirements such be considered as part of the physical requirements. Power (TBD), Fluids (TBD), Data Processing (TBD), etc. These are requirements for preparing off-line GSE propellant servicing equipment, which is required for Final Servicing.